Galileo R&D activities

Ergebnisse der ersten beiden Galileo-Calls und Ausblick auf den 3. Call

DLR - Info Day 10.01.2006

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Head of Technical Division
Galileo Joint Undertaking
Ziel & Plan

- Development of the User Segment
- 1st call and 2nd call Main Results
- Introduction to the 3rd call
- Galileo -
Space and Ground segment

- Galileo infrastructure
  - Space segment
  - Ground segment

- Launch of GIOVE A: 28th December 2005
- Launch of GIOVE B: before mid 2006
- In-Orbit Validation starting in 2008 with 4 Satellites

- Products delivered by the infrastructure are SIGNALS
- Galileo -
User Segment

- The users are interested by SERVICES -

- The Galileo USER SEGMENT is defined as the segment that translates the SIGNALS into SERVICES for the final users -

- The USER SEGMENT is composed of:
  - Technologies (receiver, local element, …)
  - Added-value services (combined with communication, mapping, pricing services)
  - User Applications
Overall budget for the development phase

- The development of the 4 first Satellites and Ground segment (i.e. infrastructure) is financed through ESA and EU TEN budget
  **Budget: 1.500 Mio €**

- The development of the User segment is financed by EU R&D budget (Framework Program)
  **Budget: 110 Mio € at EU level (6th FP)**
  + national budgets and regional budgets

- The development of the USER SEGMENT is of paramount importance for the success of Galileo:
  - The **real market for Galileo is in the User Segment**
  - Its development gives to Europe a **chance to benefit from Galileo**
Overall Schedule - Public Private Partnership

**Development and Validation**
- 48 Months
- 1.6 Billion €
- Public
- 2 Test Satellites & 4 Operational Satellites
- Ground Infrastructure

**Deployment**
- 24 Months
- 2.2 Billion €
- 1/3 Public, 2/3 Private
- 26 Satellites
- Ground Infrastructure

**Operations and Maintenance**
- 20 Years
- Operation Period
- Operation Cost
- Finance Cost
- Replenishment Cost

**Organizations**
- EC/ESA Joint Undertaking
- GALILEO Concessionaire / GNSS Supervisory Authority
Integration of:

- Continuous operation as of mid 2005
- Safety-critical operations (Certification) mid 2006
- Decision by GJU for “Early Integration” in Concession
- Mission Requirements- and Technical Evolution
- Service Extensions (enlarging the coverage area)
- Receivers are available
Comparison

- **GPS:** about **1.5 - 2 Billion**$ investment in User Segment. Initially in the military domain followed by a technology transfer to the civil sector (spin-off). Large amount of (US) user technologies available when GPS constellation was completed.

- **GLONASS**
  The investments in the User Segment have been minimal which lead to the paradox that no receiver were commercially available when the full GLONASS constellation was in place (1994).

- **Mobile Phone Technology (=GSM)**
  - Large investments at European Level in the User Segment (Information Society Technologies) which give to Europe a leading role in this domain.
Development of User Segment

1. User needs analysis (requirements, specifications...)
   - Already for the definition of the infrastructure
   - Continuous process for the applications

2. Technical feasibility, demonstrations

3. Development and implementation of the service enablers
   - Technologies
   - Market analysis
   - Regulatory framework
   - Standard

4. Real services
From technical feasibility to real services

<table>
<thead>
<tr>
<th>Year</th>
<th>GPS</th>
<th>SBAS</th>
<th>Galileo</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>SA off</td>
<td>ESTB</td>
<td>Deployment</td>
</tr>
<tr>
<td>2001</td>
<td>L2C</td>
<td>EGNOS</td>
<td></td>
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<tr>
<td>2002</td>
<td>L5</td>
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<td>2007</td>
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<td>2008</td>
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<td>2009</td>
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<td></td>
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<tr>
<td>2010</td>
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</tbody>
</table>

User requirements

Technical Demos

Service Enablers Development

EGNOS based services

Galileo based services

EC/ESA | Galileo Joint Undertaking | Galileo Supervisory Authority

Concession process | GALILEO Concessionaire

Galileo R&D activities – GJU presentation
Galileo Research and Development activities

<table>
<thead>
<tr>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
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</table>

**1st Call activities (18.9 M€)**

**2nd Call activities (80.6 M€)**

**3rd Call activities (10 M€)**

**EC 7th FP**

- Preparation
- Calls
## First Call Status

<table>
<thead>
<tr>
<th>Activities</th>
<th>Budget (M€)</th>
<th>Project acronym</th>
<th>Status: Activities started early 2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>A User Receiver Prelim. Development</td>
<td>3.8</td>
<td>GARDA</td>
<td>MTR in February 2005</td>
</tr>
<tr>
<td>B Galileo Local Component Develop.</td>
<td>3.8</td>
<td>GILT</td>
<td>MTR in March 2005</td>
</tr>
<tr>
<td>C Introduction of Galileo Services using EGNOS</td>
<td>4.7</td>
<td>ADVANTIS SCORE, SCORE, VERT, MARGAL</td>
<td>Phase B initiated, Phase B initiated, Phase B initiated, Phase B initiated</td>
</tr>
<tr>
<td>D Application Market Development</td>
<td>1.7</td>
<td>PRODDAGE</td>
<td>Different market analysis launched: EGNOS Africa; CS; Road regulation; Rail E. Europe</td>
</tr>
<tr>
<td>E Mission Implementation</td>
<td>4.9</td>
<td>GEM</td>
<td>MTR January 2005</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>18.9M€</strong></td>
<td><strong>8 Contracts</strong></td>
<td></td>
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</tbody>
</table>

Galileo R&D activities – GJU presentation
## Indicative Budget Allocation

<table>
<thead>
<tr>
<th>Area 1</th>
<th>Area 2</th>
<th>Area 3</th>
</tr>
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<tbody>
<tr>
<td><strong>1A User community</strong></td>
<td><strong>1B Technological</strong></td>
<td><strong>Co-ordination of Galileo Research and Development Activities</strong></td>
</tr>
<tr>
<td><strong>GNSS introduction in the LBS sector 3.2MC</strong></td>
<td><strong>Galileo Mass-market receiver development 2.5MC x 3</strong></td>
<td>Co-ordination of Galileo Research and Development Activities</td>
</tr>
<tr>
<td><strong>GNSS introduction in the Road sector 3.2MC</strong></td>
<td><strong>Galileo Professional receiver development 2.6MC x 2</strong></td>
<td>- International</td>
</tr>
<tr>
<td><strong>GNSS introduction in the Rail sector 3.2MC</strong></td>
<td><strong>Galileo Advanced Concept 2.8MC</strong></td>
<td>- Expert group</td>
</tr>
<tr>
<td><strong>GNSS introduction in the Maritime sector 3.2MC</strong></td>
<td><strong>Implementation of Galileo Time Service Provider Prototype 2.8MC</strong></td>
<td><strong>Innovation by Small and Medium Enterprises 300k€ x 10</strong></td>
</tr>
<tr>
<td><strong>GNSS introduction in the Aviation sector 2.2MC</strong></td>
<td><strong>Implementation of Galileo Geodetic Service Provider Prototype 1.8MC</strong></td>
<td></td>
</tr>
<tr>
<td><strong>GNSS for special user community 1.25MC x 4</strong></td>
<td><strong>Interference Detection, Mitigation and Isolation 1.8MC</strong></td>
<td></td>
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</table>

**Area 1** 50%  
**Area 2** 100%  
**Area 3** 70%
Additional Budget Allocation (13.7M€)

- Additional activities in the Small and Medium Enterprise Specific call (call 2423)

- Concession: involvement of more user communities through the “Special User Community” activity (call 2412)

- Increase of the International Activities

- Other additional activities (Area 2)
1\textsuperscript{st} and 2\textsuperscript{nd} Call Activities (I)

○ Applications
  ○ Applications and Services development based on EGNOS integrity in the 1\textsuperscript{st} call

  ○ 2\textsuperscript{nd} call: Development of GNSS (EGNOS + Galileo) services and applications in major user communities:
    ○ All major transport domains
    ○ LBS
    ○ Scientific and Professional domains
    ○ Agriculture...

○ Mission
  ○ Standardization
  ○ Activities complementing GalileoSat:
    ○ Time and Geodesy Service Provision
    ○ SAR MEOLUT development
  ○ Activities related to frequency
  ○ Definition and evolution of the mission
1st and 2nd Call Activities (II)

○ Receivers
  ○ Development of tools and first receiver prototype in the 1st call
  ○ Development of commercially oriented receivers in the second call through parallel contracts
    ○ Mass market receiver
    ○ Professional receiver
    ○ Safety of Life receiver

○ Local Elements
  ○ Development of the LE Building Blocks
  ○ Development of “application and service oriented” local elements in the 2nd call (in line with the different user communities requirements)
Results: Applications

- **Navigation services based on the EGNOS corrections demonstrated for:**
  - Port approach
  - Inland waterways
Results: Antennas

- Development of a 3-frequencies compact antenna for professional applications
- Innovative solution / Patent
1st and 2nd call developments (1)

- **Receiver**
  - Development of tools and first receiver prototype in the 1st call (GARDA)
  - Development of commercially oriented receivers in the second call through parallel contracts

- **Local Element**
  - Development of the LE Building Blocks in the 1st call (GILT).
  - Development of “application and service oriented” local elements in the 2nd call (in line with the different user communities requirements)
Results and Outcomes

- **GJU** has launched more than **60 projects** (including SMEs) dedicated to the development of the User Segment for an overall budget of **170 M€** (110M€ financed by GJU)

- More than **300 companies** (including a large number of **SME’s**) are now involved in the Galileo R&D activities financed by the GJU

- **280 equivalent full-time persons** are continuously working in these projects
2nd call budget repartition per country

- FR: 17.8%
- UK: 16.8%
- ES: 13.1%
- DE: 11.8%
- IT: 16.1%
- SE: 1.2%
- CA: 0.6%
- NL: 2.5%
- NO: 2.3%
- CN: 0.5%
- CH: 3.5%
- GR: 0.8%
- RU: 0.2%
- PL: 0.1%
- FIN: 0.4%
- SL: 0.1%
- PT: 2.1%
- CZ: 0.2%
- RU: 0.2%
- CA: 0.6%
- DK: 0.1%
- IE: 0.6%
- HU: 0.0%
- AT: 2.6%
- RU: 0.2%
- UA: 0.1%
- PL: 0.1%
- FIN: 0.4%
- SL: 0.1%
- PT: 2.1%
- CZ: 0.2%
- RU: 0.2%
- CA: 0.6%
- DK: 0.1%
- IE: 0.6%
- HU: 0.0%
- AT: 2.6%
Introduction to the 3rd call
Drivers and rational for the 3rd call

- European GNSS implementation (EGNOS and Galileo)
  - EGNOS open service is now available
  - Galileo system test bed (GIOVE) in early 2006 and In Orbit Validation (IOV)

- Evolution of GNSS:
  - Evolution of Users expectations
  - Interoperability with other GNSS
  - Evolution of technologies

- Setting up of the Concession
  - Views of the concessionaire

- Support to innovation and SME’s

- Preparation of the 7th framework programme
3rd call

- **Tracking and Tracing Technologies for EU Regulated Services**
  - Support to introduction of GNSS in existing or planned EU regulation and initiatives

- **Galileo Applications in the Emergency Management**
  - Consolidate the potential of Galileo in support to emergency management and promote its use in the user community

- **Galileo Time and Synchronisation Applications**
  - Support the introduction of GNSS in the Time and Synchronisation User Communities, and develop this market
3rd call

- **Public Regulated Service User Segment**
  - Promote the use of PRS in different User Communities, analyse the different aspects linked to the use of PRS

- **Education, Research and Innovation in the field of GNSS**
  - Analyse and draft recommendation on the improvement of the European situation in term of education, research and innovation in the field of GNSS.
Thank You ... 

...for your attention!